[SEQ CHAPTER \h \r 1]**UNITED STATES ENVIRONMENTAL PROTECTION AGENCY**
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

MEMORANDUM

SUBJECT: Toxicity Tests and pH Results Interpretation

DATE: 2-23-10

FROM: Jennifer Dodds
Environmental Scientist

TO: Juan Thomas
Project Manager

I have drafted some language for possible inclusion in our forthcoming letter to BASF regarding the elevated pH levels detected along their Northworks Site. This language also attempts to summarize the recent toxicity test results that were obtained by EPA. Please feel free to include at your discretion.

1. Regarding the argument that the sediment pH is not addressed in the Michigan surface water criterion or that there is no pH criterion applicable to bulk sediment:

MDEQ – RRD Op Memo No.4, Attachment 3 – Sediments, Section 2.0 Characterization
"Proper characterization of sediment must determine the potential for contaminated sediments to result in violations of water quality standards (Section 20120a(15)) or **use impairments specified in R 299.5730(1) and the nature and extent of contamination."**

> R 299.5730 (1), Rule 730
> "Any remedial action plan that addresses surface water or sediments associated with waters of the state shall include site-specific cleanup criteria established by the department on the basis of sound scientific principles and evaluation of **bulk sediment chemistry, sediment toxicity and benthic community populations. Criteria shall be established considering the need to eliminate or mitigate the following use impairments, as appropriate to the facility in question:**
> Where (f) is: **"Degradation of benthos."**

MDEQ – RRD Op Memo No.4, Attachment 3 – Sediments, Section 2.2
"Where sediment contamination exists, a work plan must be prepared to determine the **lateral and vertical extent of the hazardous substances contamination."**

MDEQ – RRD Op Memo No.4, Attachment 3 – Sediments, Section 4.0
"Where after site characterization the nature and extent of sediment contamination above screening levels and **any use impairments are well defined,** and bioaccumulative contaminants are not an issue, it may be more **cost effective or otherwise appropriate to proceed with remedy design and implementation to address contamination above screening levels, rather than proceed with extensive toxicity testing and site-specific criteria development. Although screening levels would not be considered enforceable cleanup criteria…they would be protective and if they were met any use impairments addressed, further response action to address sediment contamination would not be required."**

BASF spent a portion of their January 26, 2010 data share meeting purporting that the pH criterion is not applicable to "bulk" sediment. However, Michigan Rule R 299.5730 (1), Rule 730 states that any sediment remedial action plan or clean up criteria would be developed in part based on bulk sediment chemistry. These statements appear to be in conflict with one another. In addition , MDEQ – RRD Op Memo No.4, Attachment 3 – Sediments, Section 2.2 requires the vertical extent of sediment contamination be determined. Therefore it stands to reason that any sediment contamination found at depth would be of concern and may possibly warrant a response action; not simply surface water quality or surface sediment quality. At the January 26, 2010 data share meeting, BASF implied that past EPA and MDEQ sediment response actions were solely driven by surface water pH levels. Again, this appears to be an inaccurate statement when you look at Michigan's Water Quality Rules.

Regardless of where in the sediments the water quality standard applies, MDEQ – RRD Op Memo No.4, Attachment 3 – Sediments, Section 2.0 Characterization, discusses the requirement to address beneficial use impairments. EPA toxicity tests have shown that along site sediments appear to be acutely toxic to the benthic community. BASF appears to be in violation of the pH water quality standard as it applies to beneficial use impairments, most specifically to the degradation of the benthos.

2. Toxicity Tests:

The Great Lakes Environmental Center, Inc. (GLEA) completed and analyzed the *Chironomus dilutus (tentans)* and *Hyalella azteca* 10-day whole sediment survival and growth toxicity tests for whole sediment toxicity assessment. Upon analysis it was determined that the *C. dilutus* and *H. azteca* sediment toxicity tests were conducted following the standard EPA protocols and are valid assessments of sediment toxicity. There was a statistically significant reduction in *C. dilutus* survival for two of the eight investigative samples and a statistically significant reduction in growth, expressed as biomass, in six of the eight investigative samples after 10 days of exposure, when compared to reference sample SPI-U16. Similarly, when compared to reference sample SPI-U10, there was a statistically significant reduction in *C. dilutus* survival for five of the eight investigative samples and a statistically significant reduction in growth, expressed as biomass, in two of the eight samples. There was a statistically significant reduction in *C. dilutus* survival for four of the eight investigative samples and a statistically significant reduction in growth, expressed as biomass, in three of the eight investigative samples after 10 days of exposure, when compared to reference sample SPI-U04. The results are similar for *H. azteca* with seven of the eight investigative samples experiencing a

statistically significant reduction in survival and one of the eight samples experiencing statistically significantly reduction in growth, after 10 days of exposure, when compared to SPI-U16. There was a statistically significant reduction in *H. azteca* survival for seven of the eight investigative samples when compared to reference samples SPI-U10 and SPI-U04. The *H. azteca* growth was significantly reduced in one investigative sample when compared to reference sample SPI-U04.

When the three acceptable reference sediments (SPI-U16, SPI-U10, and SPI-U04) are pooled together and compared to the investigative samples, there was a statistically significant reduction in *C. dilutus* survival for seven of the eight investigative samples and a statistically significant reduction in growth, expressed as biomass, in all of the samples. Again, the results are similar for *H. azteca* with four of the eight investigative samples experiencing a statistically significant reduction in survival and seven of the eight samples experiencing statistically significantly reduction in growth, after 10 days of exposure.

The conclusion that can be drawn from all these results is that the BASF along site sediments appear to be acutely toxic to the benthic community. The investigative sample sediments, those along site BASF, were statistically different than both the mutually agreed upon reference sediments and laboratory control sediments. The investigative samples experienced a statistically significant reduction in survival and growth as compared to both the mutually agreed upon reference sediments and laboratory control sediments. Again, the conclusion can be drawn that the BASF along site sediments appear to be acutely toxic to the benthic community.

3. Chloride Ion Levels:

Ion Chromatography tests were run on sediments collected from along site BASF property and were found to have an overwhelming amount of chloride ion as compared to the other anions. These levels of chloride are not believed to be found at these high levels elsewhere in area sediments. According to the BASF Corporation-RFI dated March 22, 1995, "Distiller Blow Off (DBO) contained a mixture of sodium carbonate, calcium chloride, sodium chloride, calcium sulfate, sodium sulfate, and some excess lime." In addition, BASF's own statistical results completed as part of their benthic community analysis point to an approximately 80% difference in chloride ion levels along site BASF sediments versus upstream sediments and an approximately 40% difference in the pH levels along site as compared to upstream locations. Meaning that BASF acquired similar results to those acquired by EPA; Elevated pH levels and chloride ion levels in along site BASF sediments as compared to the mutually agreed upon upstream reference sediments. EPA contends that the light, white or grayish material that was seen in several of the sediment core photographs is DBO. EPA also contends that this DBO is the cause of both the elevated pH levels and chloride ion levels.

4. Difference in pH between sediment core, porewater, and surface water: (Dave Petrovski may be able to articulate this point better)

During the last data share meeting on January 26, 2010, BASF suggested that the differences seen in the pH measurements taken from the sediment core, porewater, and surface water were due to the physical disruption that occurs when the core itself is taken. It was also

suggested that oxidation was taking place and was a contributor to the elevated pH levels in the sediment cores. EPA contends that the sediments from the cores are reaching a true equilibrium state without the contribution of porewater and surface water to aid in diluting the pH level. EPA also contends that this elevated pH in the sediments themselves is due to the DBO buried in the sediments which is upwelling through the groundwater to the surface. As the DBO impacted, and therefore elevated pH groundwater approaches the surface, it is diluted through mixing with porewater and surface water to approach a more neutral pH. This is demonstrated through the stratification of pH levels. Most of the highest pH levels found within the sediments are found at depths of 0-2 feet. A progressively more neutral pH is found as you move toward the surface of the sediments and the porewater, to finally reaching all neutral pH readings in the surface water. However, as EPA's toxicity tests show, this groundwater surface water dynamic is still having an acute toxicity effect on the benthic community. This acute toxicity effect can be considered degradation of the benthos and is a violation of water quality standards as they apply to beneficial use impairments.